DNV·GL

ENERGY

JIP coupled analyses of FOWTs

Towards a new Recommended Practice

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Presentation overview

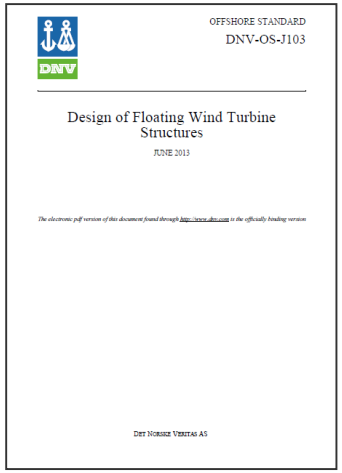
Project rationale

Overview & Status

Timeline & collaborations

DNV-OS-J103 Design of Floating Wind Turbine Structures

- Published June 2013
- Can be downloaded for free on **www.dnvgl.com**
- Developed through a Joint Industry Project (JIP) during 2011 – 2013
- Industry hearing April 2013
- Participants:


OFFSHORE STANDARD
DNV-OS-J103

Design of Floating Wind Turbine Structures

JUNE 2013

The electronic pdf version of this document found through http://www.dnv.com is the officially binding version

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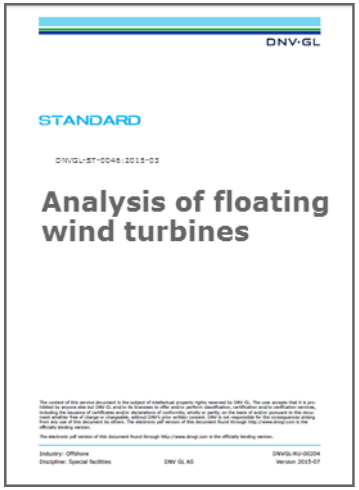
JIP scope

JIP main scope

- The main scope of the project is to produce a Recommended Practice (RP) on Coupled Analysis of Floating Wind Turbines



Challenges

- Maturity of the industry
- Clear conclusions

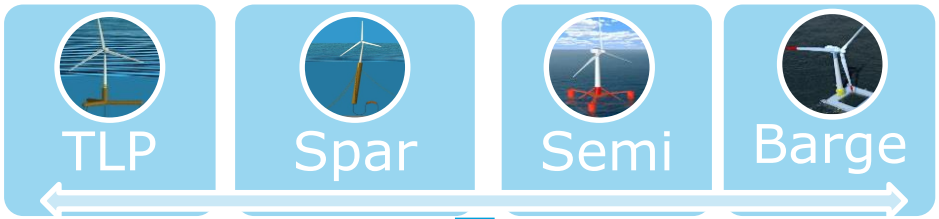
What the project IS

- Collecting experience
- Verifying methodologies
- Concluding on best practices for a given scope

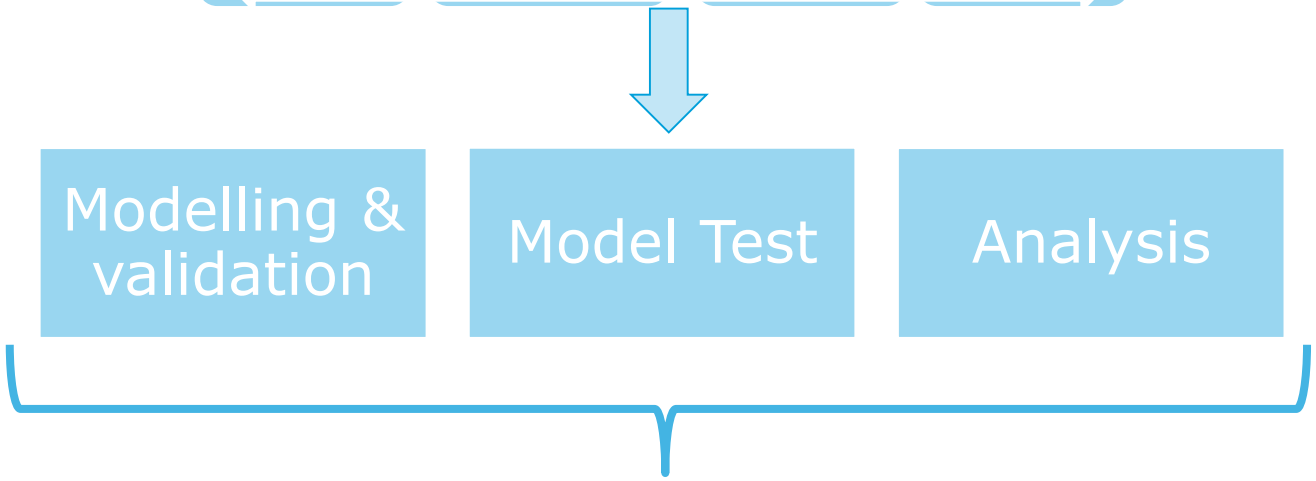
What the project IS NOT

- NOT Numerical code benchmark
- NO New model tests
- NO developing new methods

Experience used by three working groups

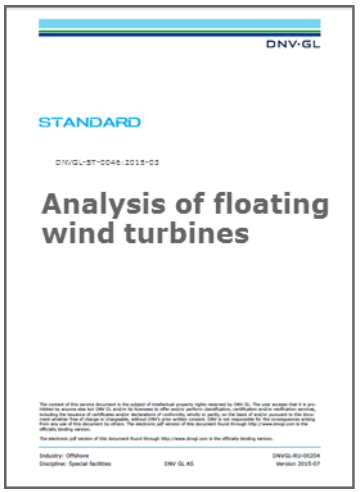


- Practical experience
- Numerical model
- Validation data

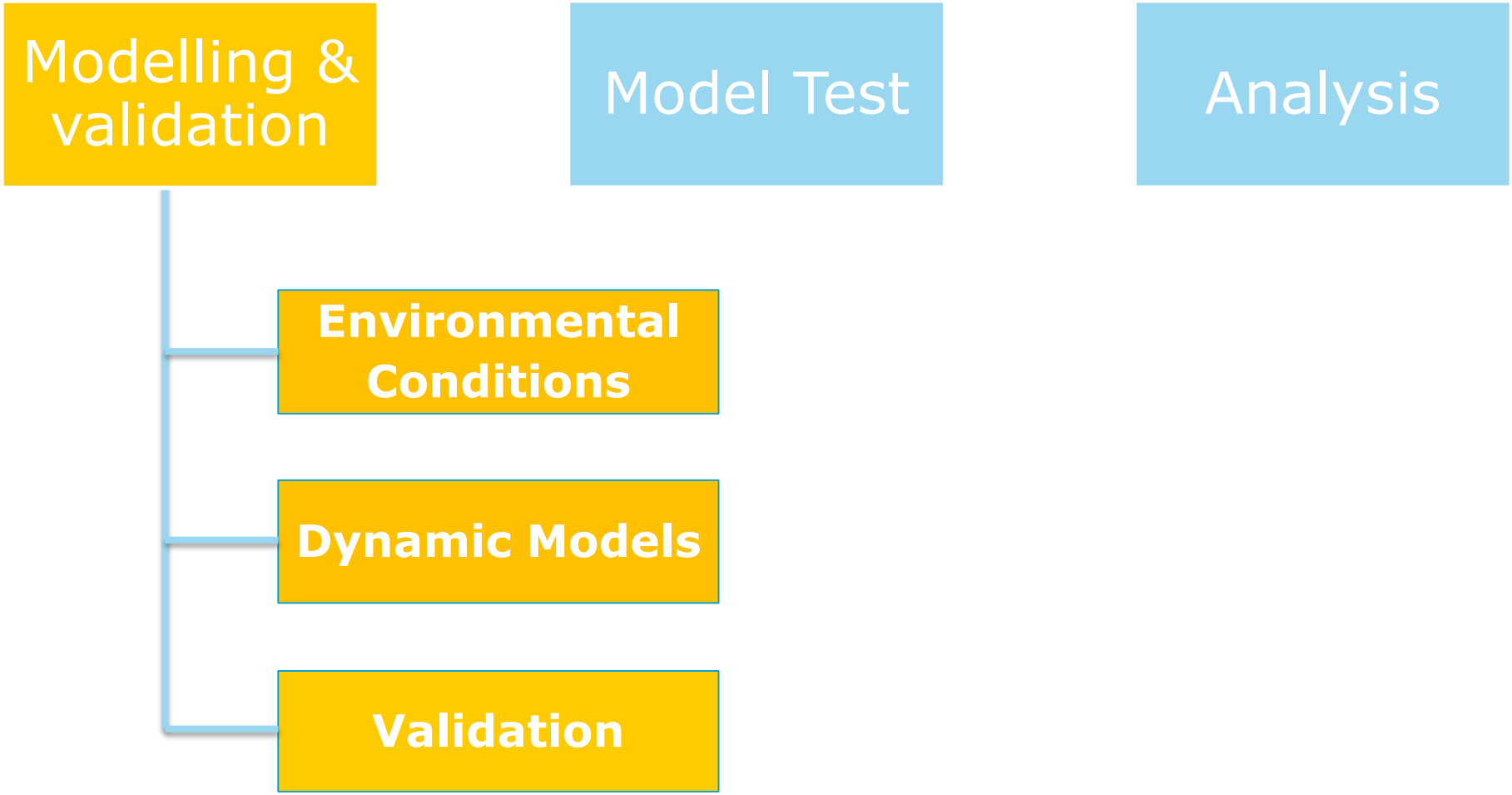


Industrial agreed recommended practices, based on:

- Experience from the selected case studies
- Experience from all participants
- New analysis run during the project to validate/integrate the state of art experience



Modelling and validation



Modelling – Environmental conditions

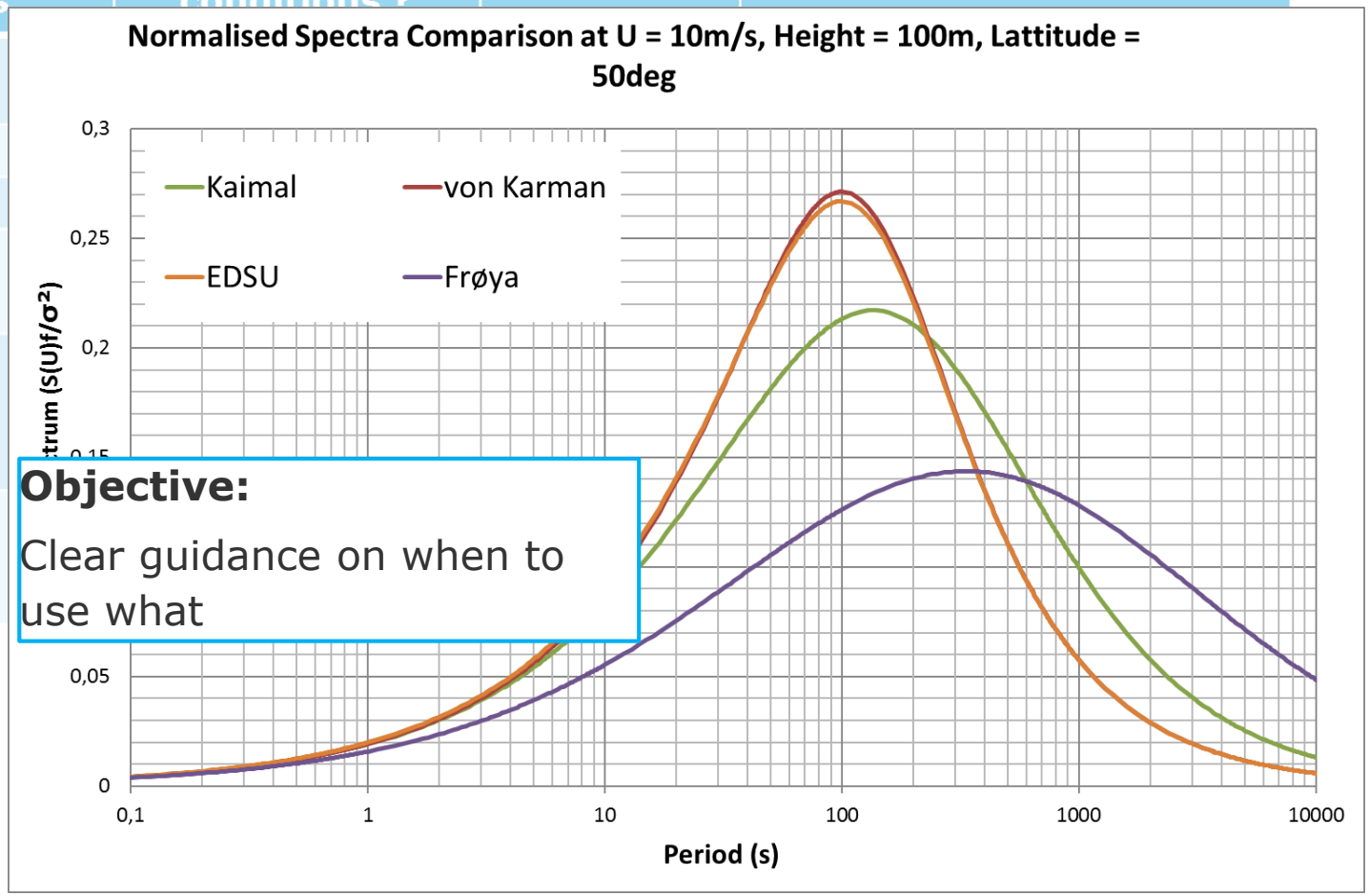
Recommendations For Modelling Environmental Conditions

- **Wind**
- Waves
- **Current**
- Wave current interaction
- **Tide**
- Seismic
- **Tsunamis**
- Ice

- Building on available standards, e.g. DNV-RP-C205
- Clarify applications for floating wind

Modelling of environmental conditions – turbulence wind

Turbulence model	No. dimensions	Developed for offshore conditions ?	Industry Source	Additional comments
Kaimal	3D			
Frøya	1D			
API				
Von Karman	3D			
ESDU	3D			
Mann	3D			



Objective:

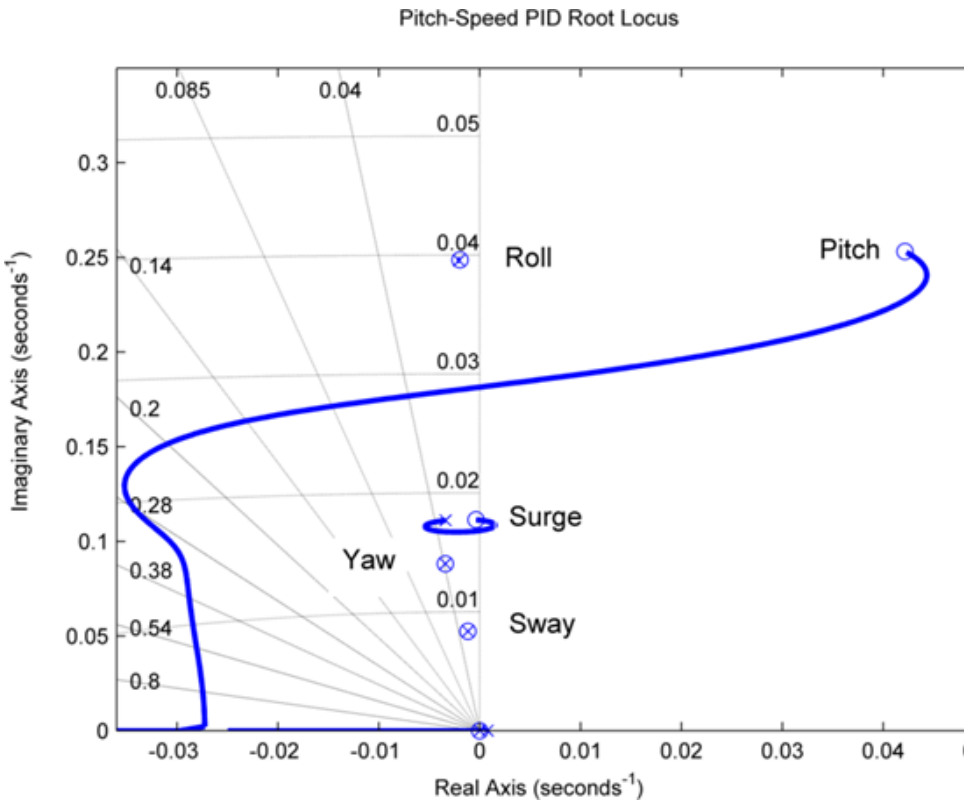
Clear guidance on when to use what

Possible controller instabilities and strategis

Many existing methods to decouple the rotor speed control loop from the platform motions.

Three groups identified:

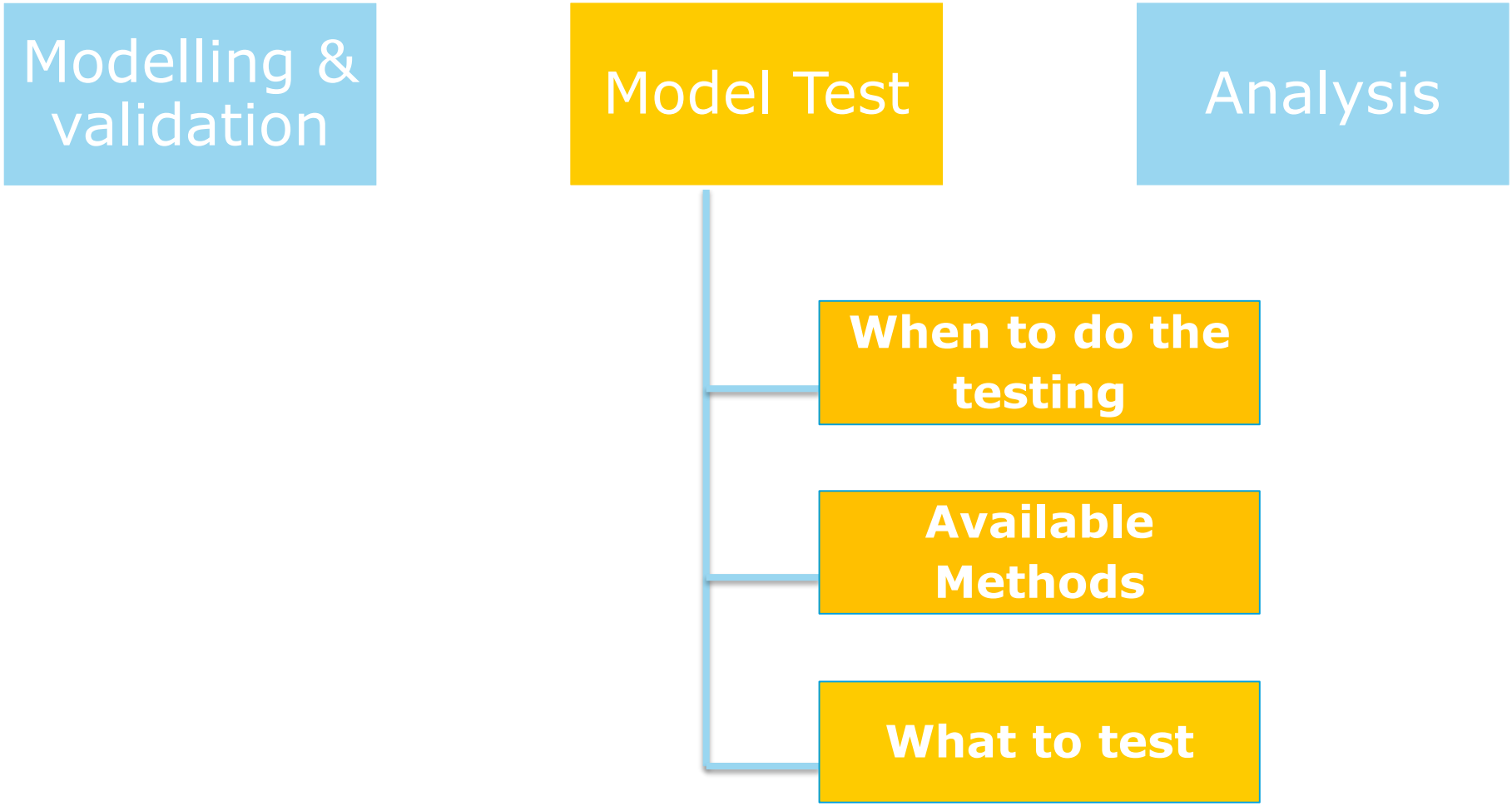
- Reduce bandwidth of the speed control loop
- Explicitly remove pitch actuation at platform frequencies
- Introduce explicit platform stabilisation loops



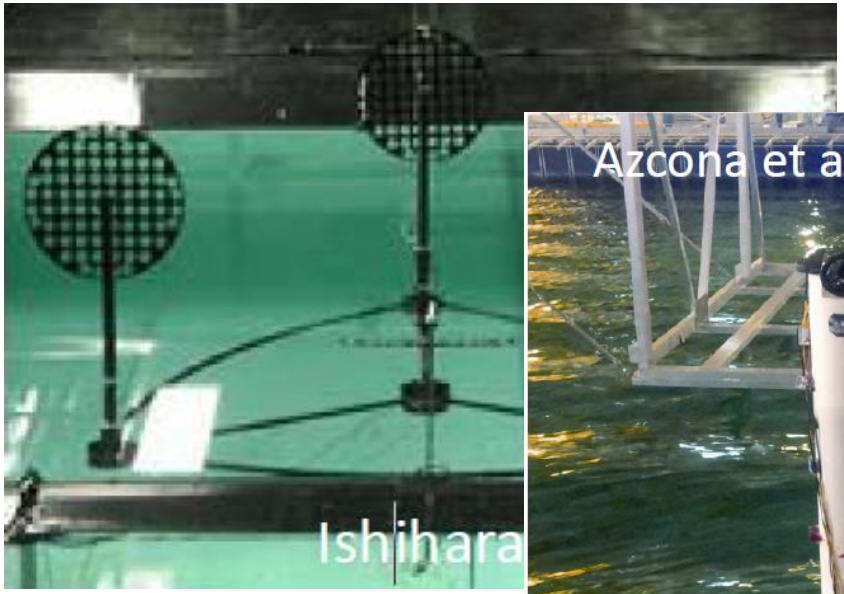
Controller – other items considered

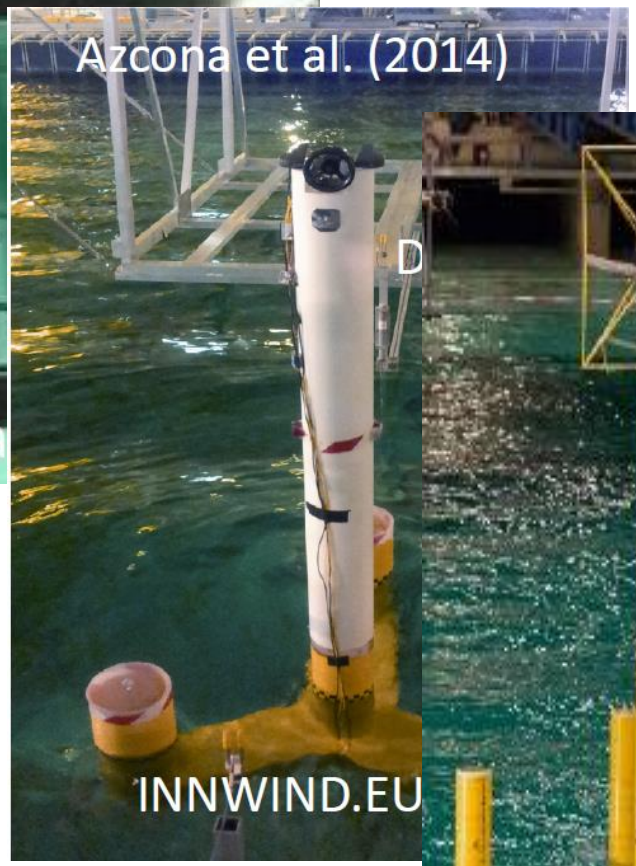
- Nonlinearity due to large system motions
- Lightly damped yaw motion
- Rotor harmonic clashes with structural frequencies (strategy to avoid)
- Monitoring
- Fidelity

Modelling and validation

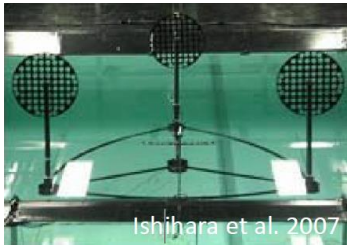


Model Tests - methods





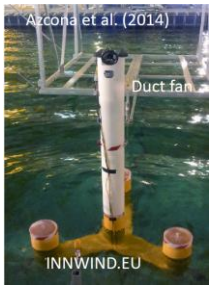
Model Tests - methods



Pro:

Contra:

Purpose



Pro:

Contra:

Purpose

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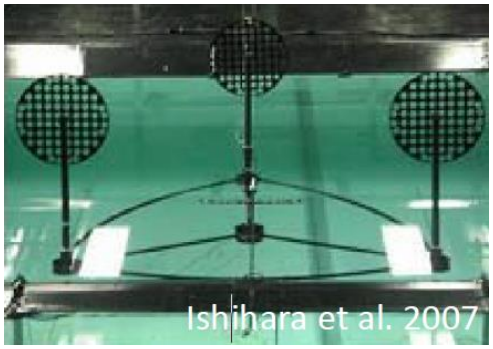
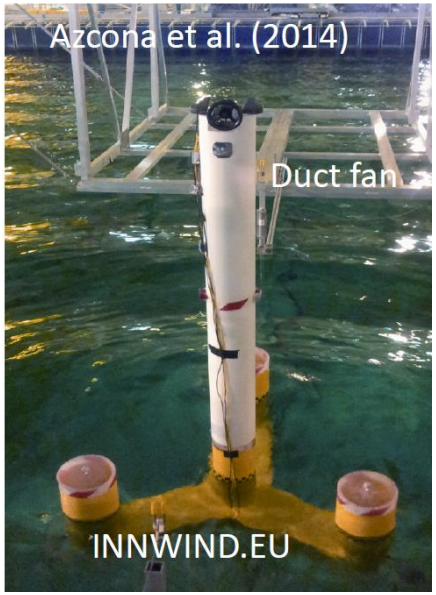
Purpose

Model test – DLCs and validation



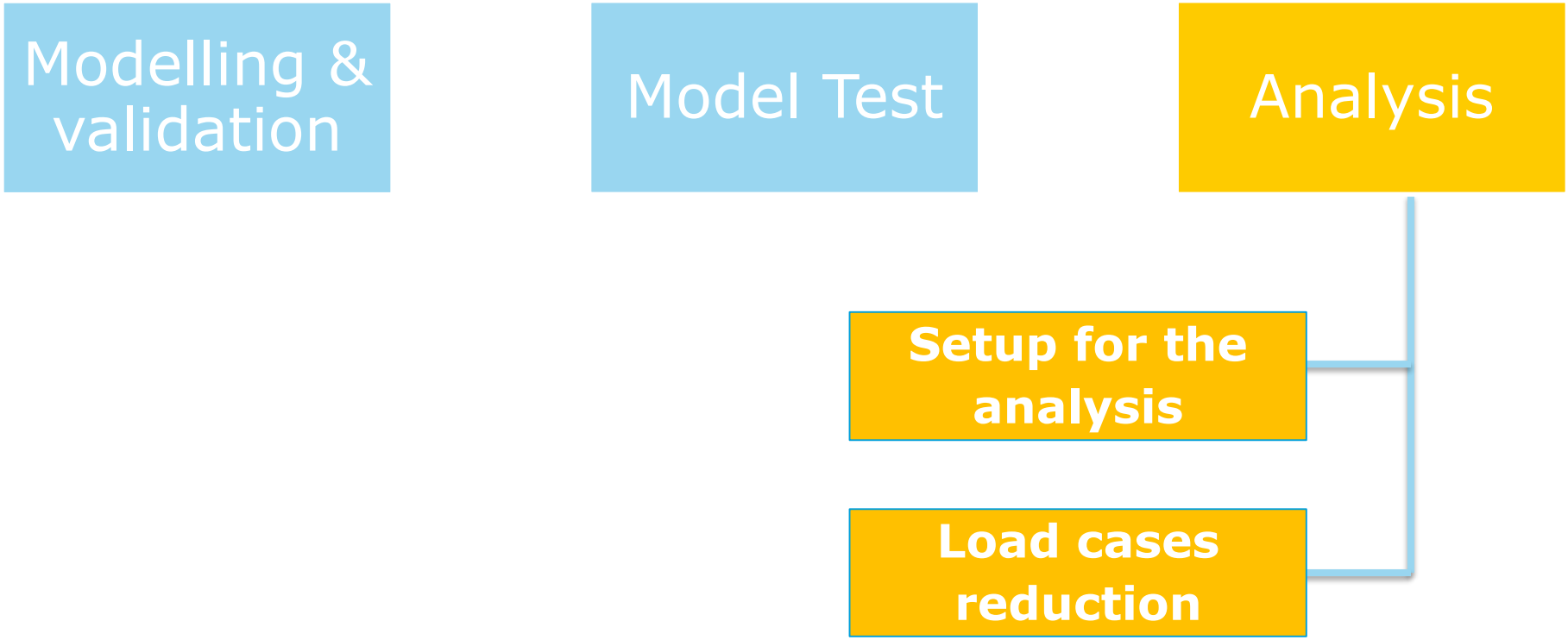


Purpose

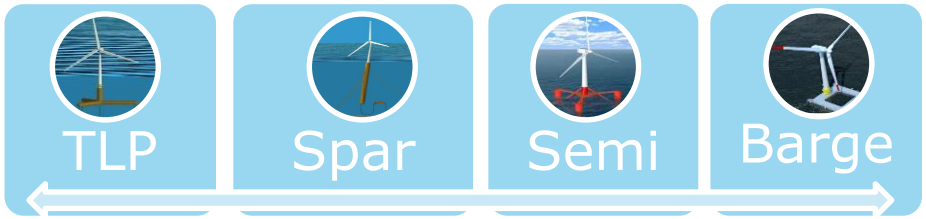
Load cases for model testing	
DLC1	
…….	
….	

Design specific considerations still to be made!

Modelling and validation



Load analysis - Database



Database from NREL

New simulations

Data from other partners

Large dataset to validate load methods and assumptions

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Possible conclusions from anaysis of database

From existing data

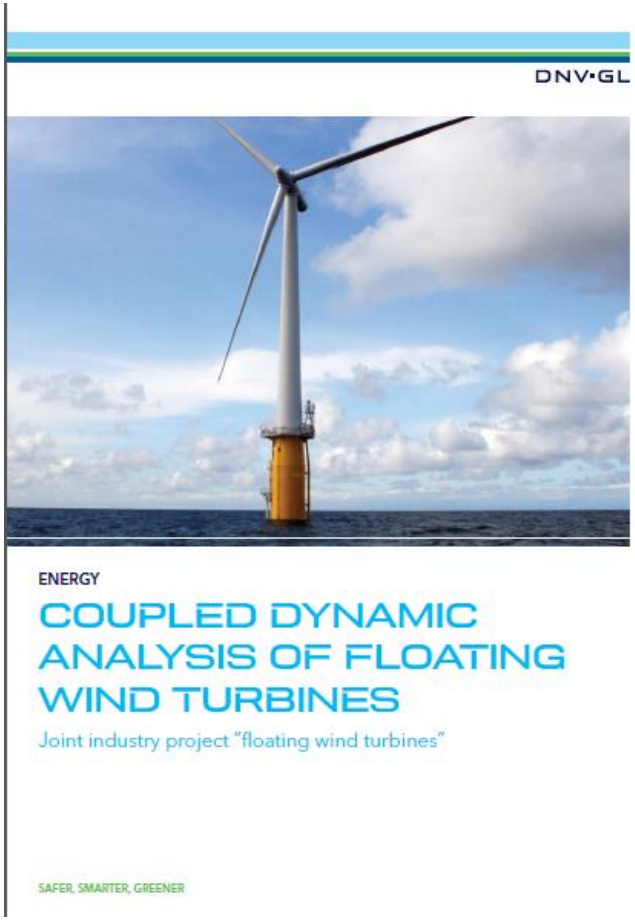
- Duration of time series
- Number of seeds
- Miaslignment
- Partial cycles
- Number of bins (wave direction and wave Tp)
- Methods for wave lumping
- Possible use of regional classes (e.g. J103, section 3.6)

From additional simulations

- Extending the conclusions to TLP and barge
- Relative importance of idling cases to fatigue
- Yaw error
- Platform orientation
- Swell
- Wave spectrum (gamma)
- ULS characteristic loads

Conclusions and collaborations

- **Comments on the contents?**
- **Methodos to be considered?**
- Timeline:
  - Work completed by September 2017
  - Final draft by end 2017
  - External hearing Q2 2018



Thanks for your attention

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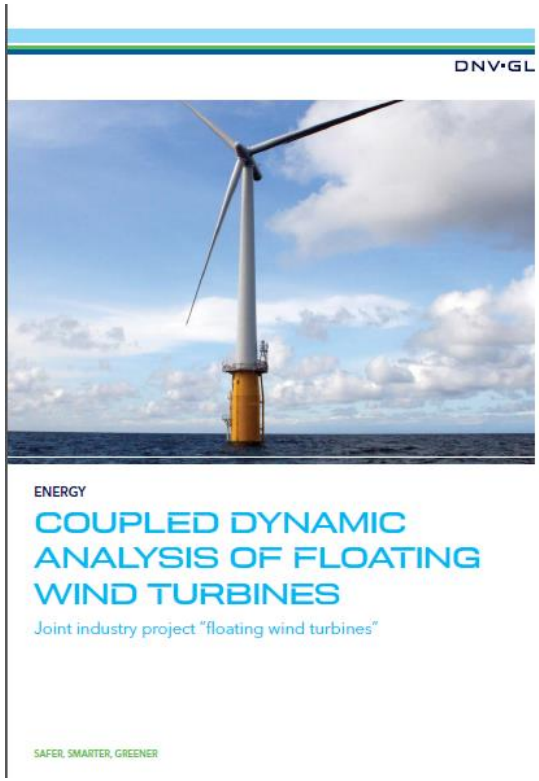

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